Rocky Intertidal Monitoring Protocol for the Redwood National and State Park, CA

Standard Operating Procedure (SOP) # 15:
Data Analysis and Report Writing

Version 1.00 (March 2008)

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version
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This Standard Operating Procedure (SOP) gives important guidelines for completing reports for the Rocky Intertidal Monitoring Program at Redwood National and State Parks. This SOP discusses annual reports and trend reports and includes procedures on when, where and to whom the reports should be electronically submitted.

I. General Considerations for Writing Reports

Annual reports are the responsibility of the Project Lead. The reports' main purpose is to archive the data and procedures for the year(s). Analysis and Synthesis or Trend reports are written every five years and are meant to be a multi-year summary showing data relevance. Trend reports will also be the responsibility of the Project Lead with assistance from the Data Analyst and Principal Investigator. Trend reports are subject to a thorough peer review process that includes park staff.

It is a recent objective of the National Park Service (NPS) Inventory and Monitoring (I&M) Program to streamline annual reporting; best efforts should be made to comply with new policies. Annual reports and trend analysis reports will use the NPS Natural Resource Publications template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Both reports should be completed using the Natural Resource Technical Report template. This template and documentation of the NPS publication standards are available at:
http://www.nature.nps.gov/publications/NRPM/index.cfm.

II. Procedures for Annual Reporting

1. Complete the annual report in a totally digital format. The annual report will be published as a technical report for the park and therefore should follow the standard, accepted format for a national technical report. If the report has pages

generated as Access reports, you will need to run the report while in Access and **save it with a .snp file extension**.

2. Files should follow the naming structure outlined in the Klamath Network File Naming Convention Guidelines (Mohren 2007). Standardized file names should adhere to the following guidelines (Figure 1):

   a. File name will be no less than ten characters in length.
   b. File names must never contain special characters (*&@%$) or spaces. When separating names, use an underscore (e.g., use_underscore).
   c. Dates will be in one of the following formats YYYYMMDD, YYYYMM, or YYYY. The most detailed date information should be used whenever possible. If the date of a file is unknown, refer to the date as "XXXX."
   d. The date should correspond to the date the document or version of the document was created. Dates should be the last component in the naming convention.
   e. The title should be the first portion of the file name, be in mixed case format, and as descriptive as possible (e.g., FileNaming_v1.00_200608).
   f. The word "Final" should be included in the name of the final document, occurring before the version number and after the title.
   g. If multiple versions of a file are created, a version number should be included in the file name following the title (SOP#16: Revising the Protocol).

Title_Final_vX.YY_YYYYMMDD

Short Description of the Document.

Use Final if it is the final Document.

Version Number (if Applicable)
Use lowercase v.
X = Major Revisions, YY = Minor Revisions
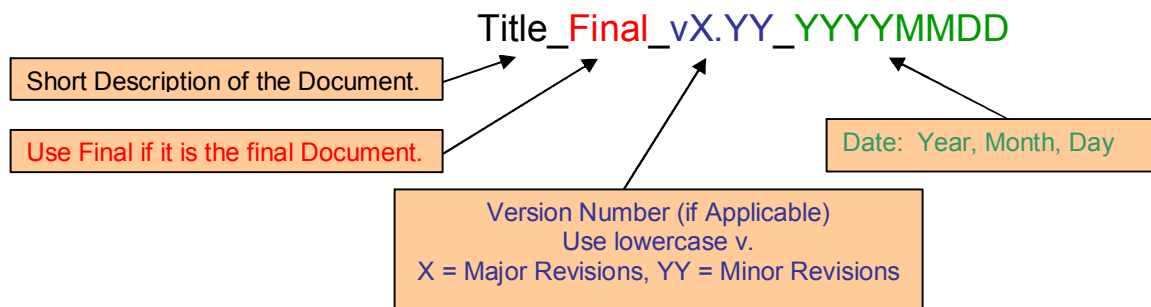
Date: Year, Month, Day

Figure 1. Basic file naming structure for the Klamath Network.

3. Collate document together, with appendices (use of templates posted on the NRPM web site is highly recommended), and submit draft manuscript and the NRPM Manuscript Submittal Form and Checklist via email to one of the NPS Key Officials listed on the NRPM web site.

4. The NPS Key Official determines whether or not additional peer review is necessary based on the manuscript content and the quality of the initial reviews, and if deemed appropriate, arranges for and oversees additional peer review. The NPS Key Official determines whether or not a management review is necessary, and if so, selects an appropriate reviewer who can verify consistency with NPS policy, clear and appropriate relation to NPS policy, and appropriate treatment to sensitive issues.

5. Once the Key Official is satisfied that reviewer comments have been adequately incorporated and the report meets the minimum standards for the series, the report is approved for publication in one of the series and the contributor obtains a report number as well as an NPS Technical Information Center (TIC) identification number following the guidance on the NRPM web site.

6. Once the report numbers are added, produce a portable document format (PDF) version of the publication and send it to the RNSP Project Manager. In addition, submit the PDF and all documents used to create the PDF (e.g., .xls, .doc, .jpeg, .ppt, .snp, etc.) to the Klamath Network (KLMN) Data Manager.

7. The KLMN Data Manager will be responsible for archiving and distributing the document following processes outlined in the KLMN Data Management Plan. Annual reports will be sent to the Resource Chiefs of each park, uploaded to the NPS Database NatureBib, and posted on the KLMN Internet and Intranet web sites. A record for the report will be created in NatureBib. Species listed in the annual report will be compared to park species lists in NPSpecies to ensure all species are included on the lists. Discrepancies between species in the report but not on the park species list will be discussed between project researchers, park staff, and the Klamath Network, with adjustments made if necessary.

III. Procedures for Trend Reporting

1. Complete a trend report every five years (or when analyses are warranted), again using a totally digital format. The trend report, like the annual report, will be published as a technical report for the park and therefore should follow a standard, accepted format for a national technical report. The use of templates posted on the NRPM web site is highly recommended.

2. The Project Lead is responsible for ensuring standard NPS font and graphic guidelines are followed and for checking report accuracy and completeness. If report pages are generated as Access reports, run the report while in Access and **save it with a .snp file extension**. This will assist when it comes times to save the entire report in PDF format.

3. The report is written at a general audience level and uses a graphic presentation of the data where possible. Since the data have already been tabularized and summarized in the annual report, trend reports should concentrate on important issues and changes observed since the monitoring program began.

4. Naming conventions for trend reports should follow a similar format to the annual report described above.

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5. After an initial review by internal staff and incorporation of revisions/comments, submit trend report for review to the Project Manager, KLMN Coordinator and Data Manager, and any additional experts that could provide critical input to the report.

6. Once reviews are complete, follow steps 3-7 under the annual reporting section of this document.

IV. Components of Annual and Trend Reports

The general outline of the annual and trend reports should include:

1. A brief Narrative section describing the project along with the goals and objectives as well as any logistic problems that were encountered and providing suggestions for preventing or coping with similar problems in the future.

2. A Methods section detailing data collection procedures and analytical techniques; this may change little from year to year but should still be included as part of each year's report. The section should highlight any changes from previous methods.

3. A Results section that describes the content of the summary tables and figures (see data analysis in next section).

4. Graphs showing trends in the mean counts of the most common species detected.

5. A brief Discussion section that highlights and interprets any notable findings, such as detections of unexpected or invasive species, unexpectedly large changes in species abundance patterns (>50% change), or factors such as unusual oceanic conditions that might have affected results.

6. An Acknowledgements section thanking individuals and organizations who contributed to the field season or the report.

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V. MARINe Data Analysis

To examine variation in the abundance of target species in space and time, summary statistics (mean and standard error of the mean) for all sites and sample periods are calculated and graphically plotted. Analyses of covariance (ANCOVA) procedures are used to assess seasonal and temporal patterns of abundance for each of the target species at each site (Miner et al. 2005). In the models, season is included as a categorical variable and time (sample) is included as the covariate. Comparisons of the community dynamics among the RNSP sites are used to track changes within the park and are also integrated within the broader sampling efforts of MARINe. This collaboration provides more power to evaluate local changes in the context of a broader system, which is able to consider large-scale changes in the environment such as geographic variation in climate.

Statistical analysis for the RNSP status and trend reports will follow a similar assessment to the trend reports completed for Cabrillo National Monument's rocky intertidal program (Becker 2006). Details of these analyses can be found in the Cabrillo National Monument Trend Report and are paraphrased as follows. The same number of fixed plots is established in each zone using a random, stratified experimental design appropriate to the highly patchy habitat (Miller and Ambrose 2000). Basic trends of percent cover, averaged by zone, are graphed for all key species for photoplots (e.g., barnacles (*Chthamulus, Balunus*, etc.), mussels (*Mytilis spp.*), rockweed species (e.g., *Silvetia compressa*), and line transects for surfgrass (*Phyllospadix spp.*). In order to minimize variability, photoplot target types are not pooled when analyzed. For example, the percent cover of mussels was considered only in mussel plots. Line transect target types are pooled, since there are only two transects of each target type in each zone. Photoplots and line transects are all "fixed," or measured in the same location every season.

The benefit of this sampling design is that it limits some of the natural variability in the system that can obscure important trends in the data. However, the tradeoff is that it is not possible to extrapolate trends in the plots to the whole area without using additional information about the area (Miller and Ambrose 2000, Murray et al. 2006). In addition, data from the same place at different times are not statistically independent and therefore the types of statistical analyses appropriate for this study are limited (Murray et al. 2006). In order to determine if there are differences between plots in zones, or between the trends in the plots in zones (a "Zone x Time" interaction effect), a repeated-measures ANOVA will be conducted on all of the trends. The analysis is conducted using SYSTAT 9 software, with seasons as the within-subject variable (dependents), zones as the between-subject variable (factors) and cover as the response variable (independents). If a zone/time interaction is found, the zone and time analyses become meaningless (Underwood 2002).

If there is no significant ($p<0.05$) zone effect or zone/time interaction for a given species, all plots from all zones are averaged into a single trend for the whole park. If there is a significant difference in the time effect among the zones, the trends for each zone are considered separately. Trends are examined using a regression analysis (Microsoft Excel 2002). For each taxon, the goodness of fit (r^2) of the linear, second, and third-order

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polynomial are determined. The regression descriptive statistics (slopes and intercepts) are also reported.

Crosstab Analysis

Crosstab analysis queries are basic crosstab queries, which can show a single species, a group of species that start with the same characters, or all species. This analysis can be used to export data directly into an Excel workbook. See "Exporting to Excel." In order to perform a crosstab analysis on the photoplot or transect data, click on the appropriate tab on the MARINe Data Analysis page (Figure 2) to run the desired query.
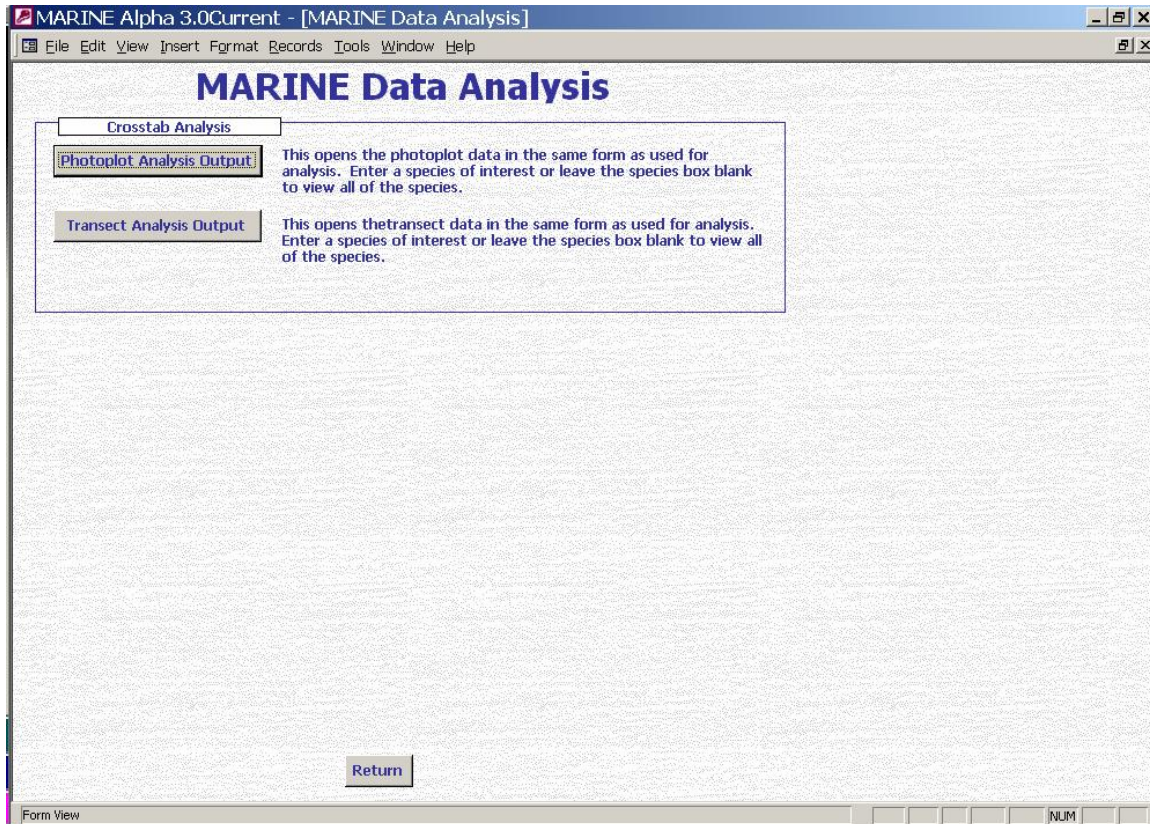

Figure 2. MARINe Data Analysis page.

Photoplot Analysis

When you click on the Photoplot Analysis button, you will be prompted to enter a species name or leave it blank for all species. You can enter a full species name or part of a name. The computer will return all species that start with the value you entered. Leaving the field blank will return all species.

Transect Analysis

The transect analysis works the same way as the photoplot analysis. When prompted, enter a species name, a part of a name, or leave it blank for all species.

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Exporting to Excel

Run the analysis you want to export. After the result set is returned, click on the Tools menu, select Office Links, and choose Analyze It with Excel. Excel will open with the exported data. The file is written to the Windows default location. If you get a message that the file is too large, you must use the export command from the File menu. See Access help for instructions on its use.

Creating Summary Charts

Summary charts are created within the MARINe database by filling in the Summary Charts page.

Create annual summaries for the RNSP sites for:
1) Photoplots
2) Sea stars
   a) Mean per site
   b) Sized grouped by bins

The chart form (Figure 3) is divided into three sections:
1. Basic Information
   - Site – Select the site to be charted.
   - Target Species – Select the target species for photoplots. Not required for sea stars.
   - Start Period.
      o Photoplots – Use with End Period to select the range of seasons.
      o Sea stars – Use to select the season to be charted.
2. Select Species for Photoplots or Sea Stars.
   - Species 1…5 – Select one to five species to chart for photoplots or sea stars.
3. Chart Selection.
   - Photoplot Charts – Selected species charted for the selected species over the time period selected.
   - Photoplot Charts Error Bars – Photoplot charts with standard error bars.
   - Sea Star Size – Sea star abundance grouped into bins for selected site and season.
   - Sea Star Mean – Mean abundance for all plots at selected site for selected season.
   - Sea Star Mean –Mean chart with standard error bars.

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Figure 3. MARINe summary charts page.

Summary Table and Trend Graph Examples

Below are examples of photoplot summary (Table 1) and a summary of motile invert counts and size frequency (Table 2). Example trend graphs of acorn barnacles from the MARINe program (Figure 4) and from RNSP (Figure 5) are also included.

Table 1. Photoplot summary of the mean percent cover by zone at Scorpion Rock, Santa Cruz Island, Spring 2004 (five plots/zone). (Channel Islands National Park rocky intertidal monitoring data excerpt.)

Zone	Bare Rock	Barnacle	Tetra-clita	Endo-cladia	Hespero-phycus	Silvetia	Mussels	Turf-weed	Leaf Barnacle	Misc Algae	Misc Animal	Other
Barnacle	36.4	17.2	0.0	25.8	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.4
Endocladia	28.4	4.0	0.4	53.8	0.0	0.2	1.4	0.0	1.4	10.0	0.2	0.2
Mussels	24.2	10.4	16.4	2.6	0.0	0.0	29.4	1.0	0.2	12.8	1.8	1.2
Tetraclita	55.4	3.6	11.4	3.8	0.0	0.0	13.4	0.0	3.0	7.2	1.6	0.6
Hespero-phycus	40.4	0.4	0.0	23.8	20.8	11.0	0.8	0.0	0.2	2.6	0.0	0.0

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Table 2. Motile invertebrate (A) size frequency measurements (mm) and (B) counts for Scorpion Rock, Santa Cruz Island, Spring 2004. Channel Islands National Park rocky intertidal monitoring data excerpt.

A.

	Nucella emarginata	*Acanthina spp.*	*Tegula funebralis*	*Ceratostoma nuttali*	*Ocenebra circumtexta*	*Lottia gigantea*
Count	8	19	4	1	84	8
Average size	17	16	17	29	12	41
Minimum size	11	7	15	29	4	12
Maximum size	22	22	19	29	36	63

B.

Zone	Barnacle					Endocladia				
Plot #	801	802	803	804	805	806	807	808	809	810
Lepidochitona spp.							2	1		
Nuttalina spp.								1		
Fissurella volcano										
Pachygrapsis				4				3	2	
Pagurus spp.										
large limpets(>15mm)										
S. purpuratus									1	
Amphissa versicolor										
Nucella emarginata	1						3			
Acanthina spp.			1		3			1	2	
Tegula funebralis						1				
Ceratostoma nuttali										
Ocenebra circumtexta			1			2	2	3	5	8
Lottia gigantea										
Pisaster ochraceus										
Littorina spp.	325	2563	413	1363	938	253	197	253	344	1225
subsample1	3	94	18	48	18	41	24	56	75	37
subsample2	9	77	11	31	24	16	20	22	14	42
subsample3	14	34	4	30	33	24	19	3	21	19

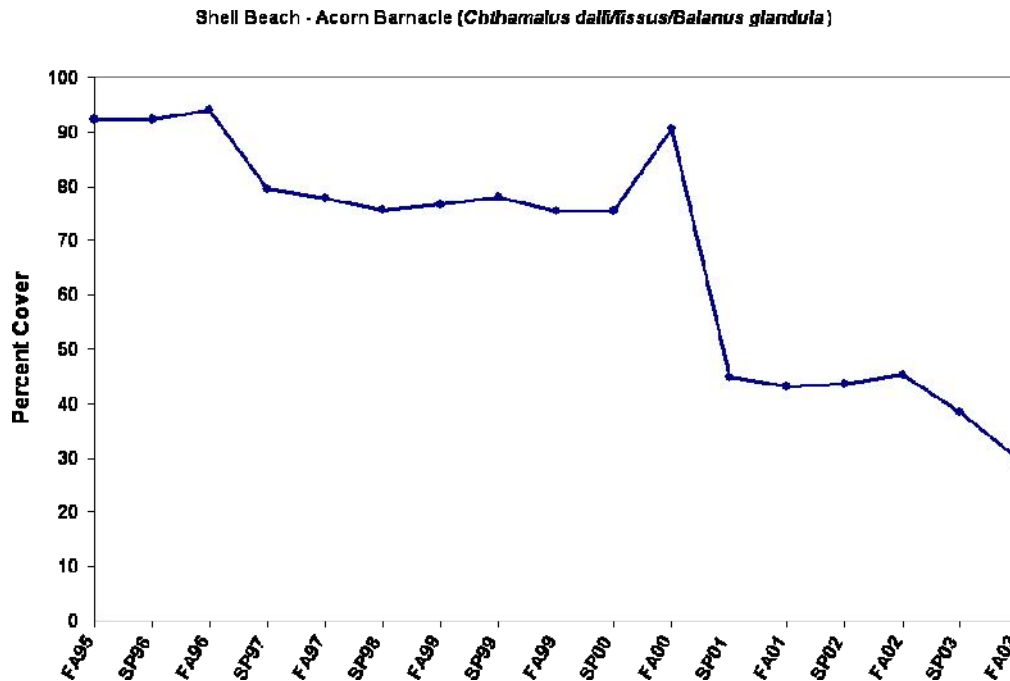**Shell Beach - Acorn Barnacle (*Chthamalus dalli/fissus/Balanus glandula*)**

Figure 1. Example trend graphs from nine years of MARINe data for Acorn Barnacles *Chthamalus dalli/fissus/Balanus glandula* at Shell Beach in San Louis Obisbo County (from http://www.marine.gov/).

Damnation Creek
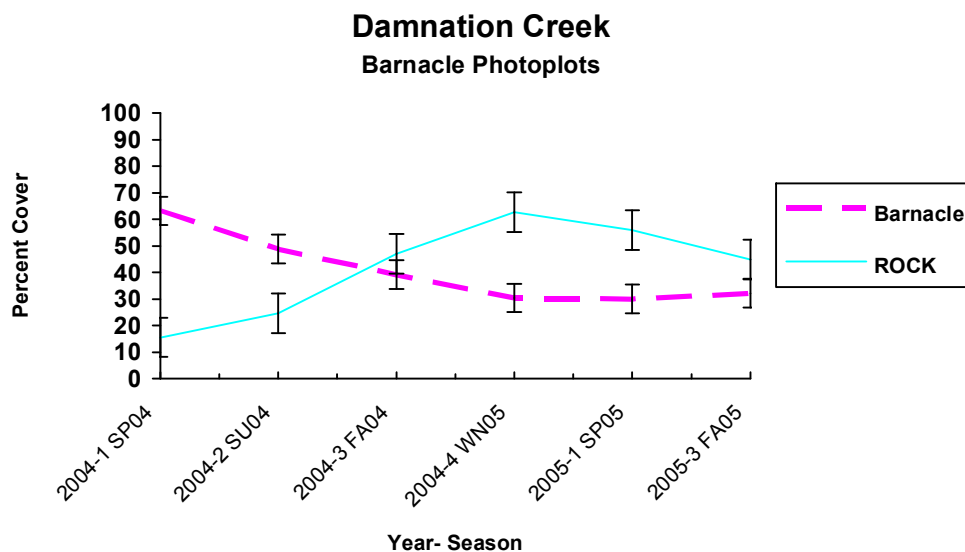**Barnacle Photoplots**

Figure 2. Example graph from two years of percent cover data for Acorn Barnacles *Chthamalus dalli/fissus/Balanus glandula* at Damnation Creek, RNSP.

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Literature Cited

Becker, B. J. 2006. Status and trends of ecological health and human use of the Cabrillo National Monument rocky intertidal zone (1990-2005). Natural Resource Technical Report NPS/PWR/CABR/NRTR—2006/03. National Park Service, Seattle, WA.

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Miner, M., P. T. Raimondi, R. F. Ambrose, J. M. Engle, and S. N. Murray. 2005. Monitoring of rocky intertidal resources along the central and southern California Mainland: Comprehensive 100 report (1992-2003) for San Luis Obispo, Santa Barbara, and Orange Countries. OCS Study, U.S. Minerals Management Service MMS 05-071.

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